UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Mr. Larry Lawson, Director
Division of Water Program Coordination
Virginia Department of Environmental Quality
629 Main Street
Richmond, VA 23219

Dear Mr. Lawson:

The Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Loads (TMDLs) report for the primary contact use (bacteria) impairments on Cedar and Licking Run. The TMDLs were submitted to EPA for review in April 2004. The TMDLs were established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address an impairment of water quality as identified in Virginia's 1998 Section 303(d) list.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDLs for the primary contact use impairments satisfy each of these requirements.

Following the approval of the TMDLs, Virginia shall incorporate the TMDLs into the appropriate Water Quality Management Plan pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please don't hesitate to contact Mr. Thomas Henry at (215) 814-5752.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure

Decision Rationale

Total Maximum Daily Loads for
the Primary Contact Use (Bacteriological) Impairments on Cedar Run and Licking Run

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA's) rationale for approving the TMDLs for the primary contact use (bacteriological) impairments on Cedar and Licking Run. EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a margin of safety.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

II. Background

The Cedar Run Watershed is located in Fauquier and Prince William Counties, Virginia. Licking Run is a tributary to Cedar Run which is within the Occoquan River Basin in Northern Virginia. The Cedar Run impairment begins at its confluence with Mill Run and extends to its mouth, the confluence with the Occoquan River. The Licking Run impairment below the moutrh of Germantown Lake and continues to its confluence with Cedar Run. The Cedar Run Watershed is 125,000-acres in size which includes the 16,000-acre Licking Run Watershed. Both are heavily agricultural watersheds with agricultural lands making up 54 percent of the Cedar Run Watershed. Forests and developed lands make up 38 and 8 percent of the watershed area respectively.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed 23 miles of Cedar Run (VAN-A17R) and 6.5 miles of Licking Run on

Virginia's 1998 Section 303(d) list as being unable to attain their primary contact use. These segment was listed on the 2002 Section 303(d) lists as well. The decision to list these two streams was based on observed violations of the Commonwealth's bacteriological criteria. At the time of its listing, the bacteria criteria used fecal coliform as an indicator species and had an instantaneous standard 1,000 colony forming units (cfu) per 100 milliliters (ml) and geometric mean standard of 200 cfu/100ml.

Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA encouraged the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation was drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth adopted e-coli and enterococci criteria in January 2003. According to the new criteria, streams will be evaluated via the e-coli and enterococci criteria after 12 samples have been collected using these indicator species. Twelve e-coli samples were collected from both Cedar and Licking Run.

As Virginia designates all of its waters for primary contact, all waters are required to meet the bacteriological standard for primary contact. Virginia's standard applied to all streams designated as primary contact for all flows. The e-coli criteria requires a geometric mean concentration of 126 cfu/100ml of water with no sample exceeding 235 cfu/100 ml of water. Unlike the new fecal coliform criteria, which allows a 10% violation rate, the new e-coli criteria requires the concentration of e-coli to not exceed 235 cfu/ 100ml of water.

Although the TMDLs and criteria require the 235 cfu/100 ml of water concentration limit not be exceeded, waters are not placed on the Section 303(d) list if their violation rate does not exceed 10%. Therefore, Cedar and Licking Run may be deemed as attaining their primary contact use prior to the implementation of all of the reductions called for in the respective TMDL. It is necessary to keep this in mind because of the reductions required to attain the instantaneous criteria for e-coli according to the model.

The TMDLs submitted by Virginia are designed to determine the acceptable load of e-coli which can be delivered to the impaired waters, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze the impaired waters because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions. The model was run to determine the fecal coliform

---

[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

loading to Cedar and Licking Run and the loads were then converted to e-coli using a conversion factor established by the Commonwealth.

The TMDLs analyses allocate the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the streams are treated as direct deposits. Wastes which are deposited directly to the streams do not need a transport mechanism.

Local rainfall and temperature data were needed to develop the model. Weather data provides the rainfall data which drives the simulation. Hourly weather data was obtained from several local weather stations, including the Warrenton, Manassas, and Cedar Run weather stations.

Stream flow data was available for Cedar Run but not Licking Run. Therefore, simulated stream flow of the model could be compared to the observed data collected from the Occoquan Watershed Monitoring Laboratory flow gage (ST25) on Cedar Run. The model was developed through a process known as calibration, where model parameters are adjusted to create a simulated stream flow that corresponds to the observed flow data. The calibration period was from June 1990 through December 1994. To insure that the model could replicate the stream flow for other time periods, it was validated against observed flow data from 1995 through 1998. This process is known as validation and the model parameters are frozen and the model output is compared to observed data. The model for Cedar Run was used for Licking Run as well, since it is a tributary to Cedar Run.

After developing the hydrology model, the loading parameters were developed to determine the water quality of the streams. The water quality model was calibrated to observed data from 1993 through1997 and validated against water quality data from 1998 through 2000. Unlike the hydrology data, the water quality data was not continuous. The water quality model was compared to grab samples often taken on a monthly basis. Therefore, the model and data are not representing the exact conditions.

Through the development of these and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) could cause or contribute to violations of the bacteria criteria. According to the model, wildlife reductions were necessary to attain the bacterial standard in both waters. Bacteria source tracking (BST) data collected on Cedar and Licking Run indicated that bacteria from wildlife represent a significant portion of the total load,

---

[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

confirming the model results. Many of Virginia's TMDLs, including the TMDLs for Cedar and Licking Run, have called for some reduction in the amount of wildlife contributions to the impacted streams. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. In Phase 1 of the implementation, the Commonwealth will begin implementing the reductions (other than wildlife) called for in the TMDL. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. The Commonwealth has indicated that during Phase 2, it may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated for secondary contact.

After the completion of Phase 1 of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation level associated with the wildlife loading may be smaller than the percent error of the model. In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted. It should be noted that the reductions necessary to attain a 10 percent violation rate of the standard, which is the threshold for Section 303(d) Listing, would require less stringent reductions.

The TMDLs were modeled using fecal coliform loading rates as was done in previous TMDL efforts. The fecal coliform concentrations were then converted to e-coli concentrations using a translator equation developed by VADEQ. Significant reductions in the modeled load were required in order for Cedar and Licking Run to attain the new e-coli criteria in the model. More stringent reductions were required to meet the instantaneous standard than the geometric mean.

Table 1 - Summarizes the Specific Elements of the TMDLs.

Segment	Parameter	TMDL (cfu/yr)	WLA (cfu/yr)	LA (cfu/yr)	MOS
Cedar Run	E-Coli	7.97E+13	5.58E+11	7.91E+13	Implicit
Licking Run	E-Coli	9.6E+12	2.6E+09	9.6E+12	Implicit

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a primary contact (bacteriological) impairment TMDLs for Cedar

and Licking Run. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (both wet weather and directly deposited nonpoint sources) have caused violations of the water quality criteria and designated uses in Cedar and Licking Run. The water quality criterion for fecal coliform was a geometric mean 200 cfu/100ml or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a thirty-day period, most of the samples were measured against the instantaneous standard. Approximately 20 percent of the samples collected from Cedar and Licking Run violated the then applicable criteria.

The Commonwealth has changed its bacteriological criteria as indicated above. The new criteria require that the fecal coliform concentration not exceed a geometric mean of 200 cfu per 100 milliliters of water for two or more samples collected over a month nor shall more than 10% of the total samples exceed 400 cfu/100 ml of water. The new e-coli criteria requires a geometric mean of 126 cfu/100ml of water with no sample exceeding 235 cfu/100 ml. When the data is judged against the new criteria, the violation rate will increase.

The HSPF model was used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from direct deposit sources. Once the existing load was determined allocations were assigned to each source category to develop a loading pattern that would allow Cedar and Licking Run to support the e-coli water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of e-coli to these streams will ensure that the criterion is attained.

The TMDL modelers determined the fecal coliform production rates within the Cedar Run Watershed. Data used in the model was obtained from a wide array of sources, including farm practices in the area, the amount and concentration of farm animals, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, landuses, weather, stream geometry, etc.. The model combined all of the data to determine the hydrology and water quality of the stream.

The lands within the watershed were categorized into specific landuses. The landuses had specific loading rates and characteristics that were defined by the modelers. Therefore, the loading rates are different in lands defined as forested versus pasture. Pasture lands support cattle and are influenced differently by stormwater runoff. Three categories of pasture were defined in the model and each had a different loading rate as they supported a different number of cattle. The amount of cattle on the land, the time cattle spent on the land, and how much waste the cattle generated impacted the loading rate.

The Cedar and Licking Run TMDL models were run using weather data collected from

the Warrenton, Manassas, and Cedar Run weather stations. This data was used to determine the precipitation rates in the watershed which transports the on land pollutants to the streams through overland and groundwater flows. Waste that was deposited to the land or stored was subjected to a die-off rate. The longer fecal coliform stayed on the ground the greater the die-off. Materials that were washed off the surface shortly after deposition were subjected to less die-off.

As stated above the models for Cedar and Licking Run were developed using observed data collected from gage ST25 on Cedar Run. The hydrology model was calibrated to flow data collected from gage ST25 from June 1990 through December 1994 and validated against a second set of data from 1995 to 1998 from the same gage. During the calibration period, the hydrology components of the model were adjusted in order to have the simulated (modeled) flow accurately reflect the observed flow conditions. During validation, the model was then run and compared to a new set of observed flow data without adjusting the model parameters. The results of this analysis showed that the model accurately reflected the observed data. It should be noted that the model did not accurately represent the lowest flows because it was not able to account for the irrigation that withdrew water from the streams during these periods.

After the development of the hydrology model, a water quality model was developed to predict the impacts of the bacterial loading. The water quality model was calibrated to observed data from 1993 through 1997. The water quality model was then validated to data from 1998 through 2000. Once again the model reflected the observed data reasonably well. Modeled and observed violation rates and bacteriological concentration values were compared for each water. In the next step the TMDL modelers adjusted the loading rates from the various land uses and direct deposit sources to determine what reductions were required to meet the applicable water quality criteria. Since the model accurately reflected observed data it is believed that it would be able to predict the water quality as land uses and loadings in the watershed changed.

2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of bacteria to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

There are twenty facilities (two stormwater facilities, three individual permits, twelve single family homes and 3 animal feeding operations) within the Cedar and Licking Run watersheds that are regulated to control the discharge of e-coli into the streams. Two of these were municipal separate stormwater sewer systems, these facilities are stormwater driven sources of e-coli as they discharge bacteria from the land surface via the sewer system to the streams.

The WLA for these facilities was generated by determining the total loading from the urban pervious areas within the Cedar Run watershed. The load from the two MS-4 facilities were combined since their drainage areas overlapped. The other facilities WLAs were determined by multiplying their daily flow limit by the bacterial concentration of their effluent by 365 days after making the appropriate unit conversions. The maximum bacterial concentration for the three individual permits and twenty-two single family residences is 126 cfu/100ml. Each single family unit is authorized to discharge 1,000 gallons of effluent per day, the three individual permits were permitted to discharge 40,000, 7,900 and 1,500 gallons of effluent per day. Table 2 lists the WLAs for these facilities. The animal feeding operations are not allowed to discharge to the streams.

EPA regulations require that an approvable TMDL include individual waste load allocations (WLAs) for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2 - WLAs for the Cedar and Licking Run TMDLs

Facility	Permit Number	Flow (gallons per day)	WLA (cfu/yr)
U.S. Marine Corps	VA0028371	40,000	6.97E+10
Pearson Elementary	VA0027278	7,900	1.38E+10
Smith Midland Inc.	VA0084298	1,500	2.61E+09
Single Family Units	12 Permitted Facilities	1,000	1.74E+09
Prince William County	VA0088595	N/A	4.51E+11
Prince William County Schools	VAR040100		

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the impaired watersheds. The HSPF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. HSPF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various

landuses within the watershed. Table 3a and 3b list the LAs for Cedar and Licking Run. The reductions needed to insure that the instantaneous criteria is attained at all times is extremely stringent. If the 10 percent violation rate required for a water to be placed on the Section 303(d) list was used as an endpoint the reductions would be significantly less stringent.

Table 3a - LA for Bacteria (fecal coliform) for Cedar Run

Source Category	Existing Load (cfu/yr)	Proposed Load (cfu/yr)	Percent Reduction
Livestock Direct Deposit	1.60E+14	1.6E+12	99
Wildlife Direct Deposit	1.00E+14	5.0E+12	95
Cropland	7.67E+14	7.67E+14	0
Pasture	5.39E+16	2.70E+15	95
Residential	1.56E+15	7.80E+13	95
Forest	2.01E+15	2.01E+15	0

Table 3b - LA for Bacteria (fecal coliform) for Licking Run

Source Category	Existing Load (cfu/yr)	Proposed Load (cfu/yr)	Percent Reduction
Livestock Direct Deposit	3.67E+13	3.67E+11	99
Wildlife Direct Deposit	7.6E+12	7.6E+11	90
Cropland	1.27E+14	1.27E+14	0
Pasture	7.09E+15	3.55E+14	95
Residential	7.47E+13	7.47E+13	0
Forest	1.50E+14	1.50E+14	0

3) The TMDLs consider the impacts of background pollution.

The TMDL considers the impact of background pollutants by considering the bacteria load from background sources like wildlife.

4) The TMDLs consider critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Cedar and Licking Run are protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be

undertaken to meet water quality standards[3]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The HSPF models were run over a multi-year period to insure that it accounted for a wide range of climatic conditions. The allocations developed in the TMDLs therefore insures that the criteria will be attained over a wide range of environmental conditions including wet and dry weather conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods.

Bacteria loadings also change during the year based on crop cycles, waste application rates, and cattle access patterns. Consistent with our discussion regarding critical conditions, the TMDLs effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and by modifying waste application rates, crop cycles, and livestock practices.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia included an implicit MOS in the TMDLs through the use of conservative modeling assumptions in the determination of bacteria loadings and production.

7) There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES

---

[3]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

8) The TMDLs have been subject to public participation.

Three public meetings were held during the development of the TMDLs. All of the TMDLs were noticed in the Virginia Register and two local papers and open to a thirty-day comment period. The first meeting was held at the Catlett Volunteer Fire Department in Catlett Virginia on July 10, 2003. Thirty-four people attended this meeting and one written comment was received. The second meeting was held at the Nokesville Elementary School in Nokesville, Virginia on October 23, 2003. Twenty-seven people attended the meeting and two written comments were received. The final meeting was held at the H.M. Pearson Elementary School in Calverton, Virginia. Twenty-one people attended the meeting.